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IS 13173 (1991): Code of practice for handling and usage of graphite and silicon carbide crucibles [MTD 15: Refractories]



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Indian Standard

**CODE OF PRACTICE FOR
CLAY BONDED GRAPHITE CRUCIBLES AND
CARBON BONDED SILICON CARBIDE
CRUCIBLES—HANDLING AND USAGE**

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FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Refractories Sectional Committee had been approved by the Metallurgical Engineering Division Council.

The Committee felt the necessity of preparing a code of practice for the handling and usage of graphite and silicon carbide crucibles, because these are widely used by small scale industries. This code of practice will help in improving the performance and enhancing the life of crucible.

Indian Standard

CODE OF PRACTICE FOR CLAY BONDED GRAPHITE CRUCIBLES AND CARBON BONDED SILICON CARBIDE CRUCIBLES — HANDLING AND USAGE

1 SCOPE

1.1 This standard covers the guidelines for handling and usage of clay bonded graphite crucibles and carbon bonded silicon carbide crucibles.

2 STORAGE

2.1 As the clay bonded graphite crucibles and carbon bonded silicon carbide crucibles are generally porous in structure, they tend to absorb moisture from the air. Even though the crucible are provided with a special protective coating which reduces the absorption of moisture to a maximum extent, the absorption of moisture by the crucibles would not be totally eliminated during their transportation from the factory to consumer units. It is, therefore, advisable to store the crucibles under warm dry condition to permit any moisture to evaporate soon after they are received.

2.2 The crucible should be placed on wooden plank or on any metal plates/stands. The ideal temperature in stores should be 30° to 40°C (see Fig. 1).

2.3 The crucible should in no circumstances be rolled or subjected to rough handling (see Fig. 2).

3 PRE-HEATING

3.1 Before use, very slow preheating is necessary below 100°C to remove moisture without formation of steam. The different methods for preheating are given below:

- a) Put the crucible on an iron plate and put some sawdust or dung cake inside the crucible and fire them.
- b) Keep the crucible in the room/shed where the melting is going on.
- c) Keep the crucible near the furnace and rotate it slowly.

3.2 Before putting the crucible in the furnace, it is recommended to inspect the crucible for any cracks during preheating.

4 POSITION OF THE CRUCIBLE IN THE FURNACE

4.1 The crucible should be placed perfectly low in the furnace about 10 cm above the fire bars.

4.2 The crucible should not be placed too high since it will adversely affect the crucible in not getting uniform fire particularly in the upper part where proper glazed coat may not be obtained on the crucible due to insufficient heat on the upper part. The carbon inside crucible may also get burnt out.

4.3 Fuel coke should be fully covered around the crucible so that proper firing may take place. Larger pieces of coke should be at the bottom up to the level of the stand and smaller pieces thereafter up to the top of the crucible. The coke should be stoked often and replenished so that the crucible is always uniformly heated (see Fig. 3).

4.4 Care should be taken that fuel covers the entire crucible up to the top to avoid oxidation.

4.5 It is recommended that the crucible should be placed on a stand preferably made of similar crucible material specially manufactured for this purpose.

4.6 It is important that the stand placed at the bottom of the crucible should conform in diameter to the corresponding size of the crucible base and that the crucible should rest firmly on the stand with no fragments of smouldering coke or any other material between the crucible on further heating (see Fig. 4).

4.6.1 Prior to insertion of the crucible the underlay must be strewn with an insulating coating of fire clay grog (below 100 mesh) or fine coke/graphite to avoid sticking (see Fig. 5).

4.7 Coke fragments should not be too large as the cold air from below directly strike crucible walls. This will adversely affect the casting efficiency (see Fig. 6).

4.8 The grate rods should not be laid too closely. Slag free coke should be used. The grate should be frequently cleared of slag (see Fig. 7).

4.9 The crucible should not be installed too tightly in the tilting furnace. A wooden wedge which will be consumed during the heating process should be inserted between the crucible rim and the holding stone (*see Fig. 8*).

5 PROTECTION FROM OXIDATION

5.1 If a crucible is kept too long in the furnace at a low temperature its surface gets deteriorated and starts crumbling. The carbon gets burnt out and appears as if the crucible is made of reddish coloured spongy clay. If the firing is further prolonged the crucible will get perished by fractures. This is mainly due to the fact that the pure carbon/graphite in the crucible combines readily with oxygen and then gets oxidised. In order to prevent such oxidation and to protect carbon which is most essential ingredient in the crucible from destruction, proper care should be taken in maintaining suitable temperature and reducing atmosphere in the furnace though the composition of the crucible contains special admixtures which easily melt and form a protective coating on the surface of the crucible. To obtain that result, a certain minimum temperature is necessary, when melting metals such as brass, bronze, etc.

6 CHARGING OF CRUCIBLE

6.1 The charging of metal to be melted should be carried out very carefully since the crucible is made of much softer material than the metal to be melted.

6.2 Longer ingots should be inserted into the crucible vertically. Ingots should be placed loosely in the crucible leaving enough space to expand the metal with progressive heat (*see Fig. 9*).

6.3 The ingots of heavy scrap should be placed gently with the help of proper tongs (*see Fig. 10*).

6.4 Hollow scrap must be absolutely free of fluids. Care should be taken to remove fluids, if any, in such metals by evaporation before they are charged into the crucible (*see Fig. 11*).

6.5 Cold metal should not be added to a hot charge which retards melting besides damaging the crucible.

6.6 The ingot or scrap metal may be placed around the top of the furnace before charging for warming/preheating as much as possible.

6.7 Avoid hitting the top inside rim of the crucible with furnace tools, while charging metal for melting or while mixing the molten metal to prevent cracks and flaking.

7 DESIGN AND FURNACE MAINTENANCE

7.1 The furnace should be correctly dimensioned and the lining should be regularly repaired to ensure a rapid and uniform heat transfer to the charge. This will prevent flame deflection that could cause localised over heating and flame erosion.

7.2 It should be noted that too abundant fuel space around the crucible is disadvantageous as the casting efficiency slackens accordingly and never reaches the height which would be attained with the properly proportioned furnace interior.

7.3 Proper space margin should be given for allowing free expansion of crucible.

7.4 Gap between crucible and wall of furnace should be such that required amount of heat can be generated and transmitted to metal at desired level.

7.5 Vents/voids in the furnace should be avoided as they allow cold air and harm the crucible.

7.6 In the case of electro-heating furnaces the safety hatch must always be kept tightly closed (*see Fig. 12*).

7.7 Oil feed lines should be checked regularly in case of oil fired furnaces for any blockage as otherwise only cold air will penetrate to the crucible base and will create stresses. Oil feed lines should be cleaned frequently.

7.8 The burner element should be so adjusted that the flame is directed on to the crucible at a tangent which then circulates around the crucible in an upward direction (*see Fig. 13*).

7.9 The oil or gas burner should be installed at a height so that flame jet should first strike past the underlay and then circulate around the crucible in an upward direction (*see Fig. 14*).

7.10 The flame should be correctly adjusted so that unburned oil is not sprayed on to the crucible. The flame should be slightly oxidised (*see Fig. 15*).

8 FURNACE WITH FORCED DROUGHT

8.1 If the furnace is with the artificial drought, excess air pressure should be avoided throughout the firing operation as the excessive pressure will retard the operation by upsetting the correct ratio of fuel and air.

8.2 The drought should be continuously observed in order to avoid obstruction, if any, that may occur at times due to unsuitable coke, by which the fire bars will be partly blocked in allowing the flames freely. The darting flames may occur in such circumstance which may furrow the crucible material adversely affecting the life of crucible.

9 IMPLEMENTS FOR HANDLING CRUCIBLES

9.1 Special care should be taken that the tongs grip evenly and firmly (*see* Fig. 16).

9.2 The tongs must be set at adequate depth and must exercise even contact with crucible wall for facilitating firm grip.

9.3 The tongs should be regularly repaired to keep them in original shape to ensure proper grip (*see* Fig. 17).

9.4 The poking bar should be bent at the end thereby ensuring that it is unable to bypass the ingots (*see* Fig. 18).

9.5 A lighter crowbar with a flat end should be employed for removing scoria/slag from the crucible wall while crucible is red hot (*see* Fig. 19).

9.6 A suitable pair of tongs should be employed for charging heavy scrap (*see* 6.3).

10 FUEL

10.1 Solid fuel such as coke must be perfectly dried and free from sulphur to the extent possible.

10.2 The solid fuel such as coke should be broken into small pieces before use.

10.3 Good hard foundry coke is decidedly preferable to soft coke.

11 OTHER PRECAUTIONS

11.1 Care should be taken after every hour to remove any scoria/slag/dross on the interior of the crucible while it is still glowing.

11.2 Residues of metal should not be left in the crucible to cool down as these can lead to a crack on reheating.

11.3 Admixtures such as fluxes should only be added to red hot charge. Use only the required quantity of flux. Adding excessive flux will harm the crucible (*see* Fig. 20).

11.4 In order to prevent the crucible from sticking to the stand, the layer of coke powder and sawdust should be applied to the bottom of the crucible (*see* Fig. 5).

11.5 When making or mixing metal from ingot or large scrap, care should be taken that the ingots do not rest on the crucible wall as to avoid run down on the outer surface of the crucible and into the furnace.

11.6 When the crucible is taken out of the furnace care should be taken that no fragments of solid fuel adhere to the bottom as these may pierce the bottom of the crucible due to heavy weight of the metal when placing the crucible again on the stand.

11.7 After low preheating, the crucible should be gradually brought up to a dull red-heat and then rapidly up to a bright red heat, thereby permitting the requisite protective glazing to form.

11.8 The brightly red-heated crucible should be placed on a fire clay plate or preferably on an asbestos sheet when bailed out (*see* Fig. 21).

11.9 At the end of each pouring day all salt residue must be carefully removed from the crucible with a scraper (*see* Fig. 22).

11.10 In the case of extended furnace breakdown the molten metal should be poured into moulds (small ingots) which can subsequently be used without difficulty (*see* Fig. 23).

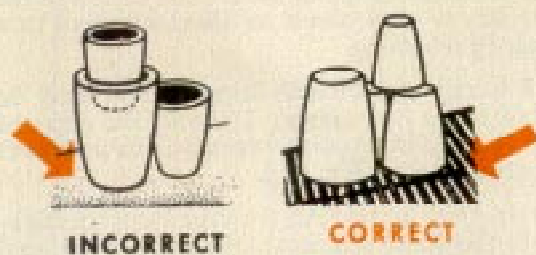


FIG. 1

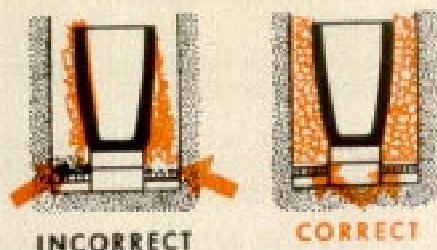


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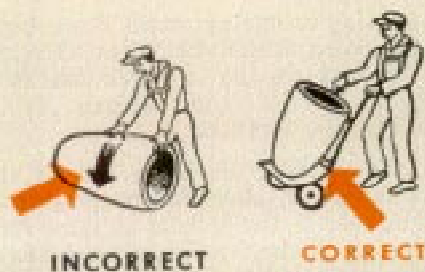


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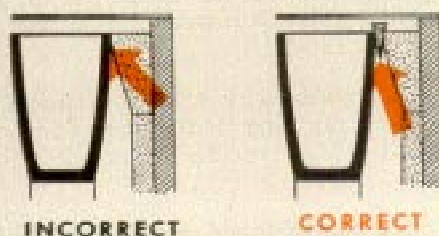


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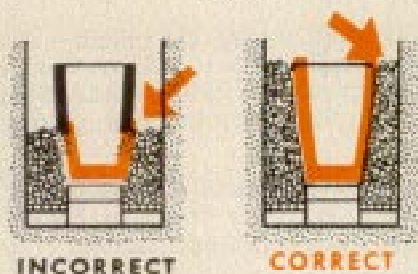


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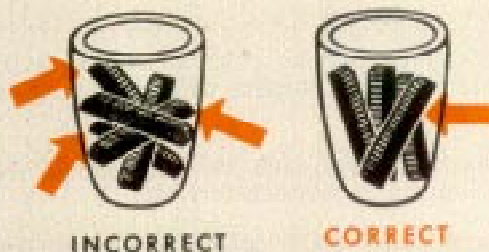


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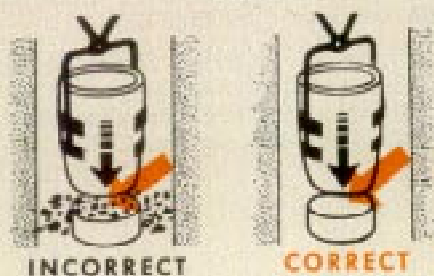


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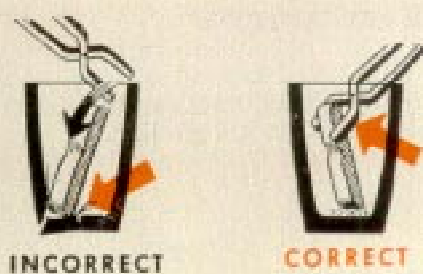


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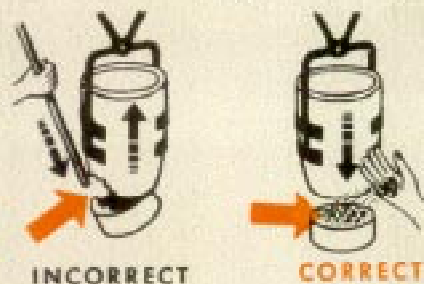


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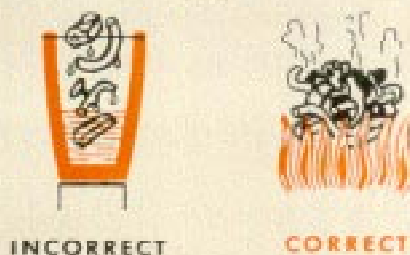


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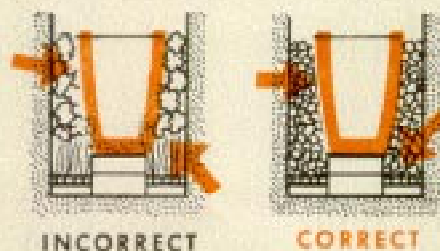


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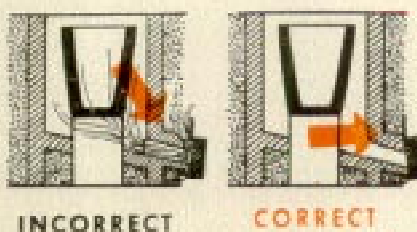
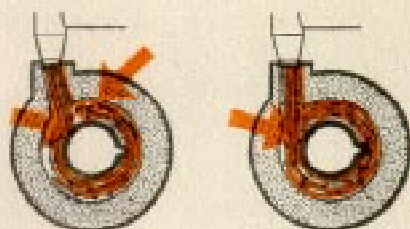


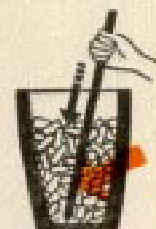
FIG. 12



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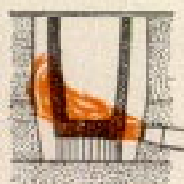
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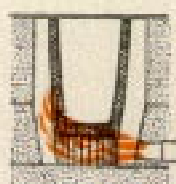
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FIG. 18



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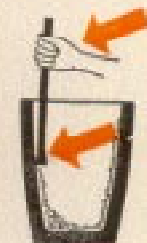


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FIG. 14

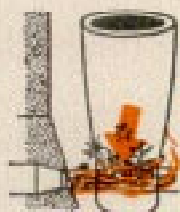


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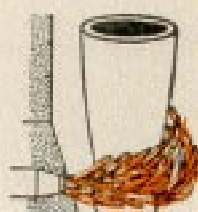


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FIG. 19

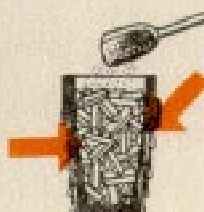


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FIG. 15



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FIG. 20



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FIG. 16

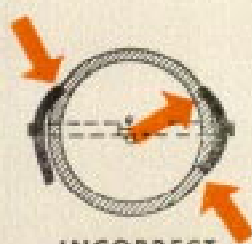


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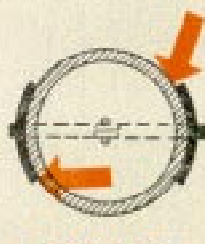


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FIG. 21



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FIG. 17

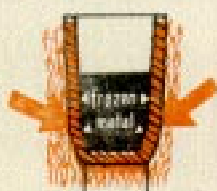


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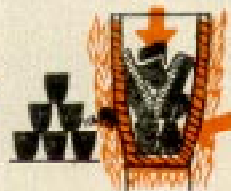


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FIG. 22



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FIG. 23

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